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Gervais, Will M.

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Analytic atheism: A cross-culturally weak and fickle phenomenon?

Will M. Gervais[a] Michiel van Elk[b] Dimitris Xygalatas[c] Ryan T. McKay[d] Mark Aveyard[e]
Emma E. Buchtel[f] Ilan Dar-Nimrod[g] Eva Kundtová Klocová[h] Jonathan E. Ramsay[i]
Tapani Riekki[j] Annika M. Svedholm-Häkkinen[j] Joseph Bulbulia[k]

Abstract

Religious belief is a topic of longstanding interest to psychological science, but the psychology of religious disbelief is a relative newcomer. One prominently discussed model is *analytic atheism*, wherein cognitive reflection, as measured with the Cognitive Reflection Test, overrides religious intuitions and instruction. Consistent with this model, performance-based measures of cognitive reflection predict religious disbelief in WEIRD (Western, Educated, Industrialized, Rich, & Democratic) samples. However, the generality of analytic atheism remains unknown. Drawing on a large global sample (N = 3461) from 13 religiously, demographically, and culturally diverse societies, we find that analytic atheism as usually assessed is in fact quite fickle cross-culturally, appearing robustly only in aggregate analyses and in three individual countries. The results provide additional evidence for culture's effects on core beliefs.

Keywords: atheism; cultural learning; dual process cognition; religious cognition; replicability; WEIRD people; culture

1 Introduction

Are analytic thinkers less religious than people who follow their gut intuitions? Prominent atheists argue that rejection of religion primarily arises from their superior analytic prowess (e.g., Dawkins, 2006). In support of this *analytic atheism* conjecture, small but stable correlations between intelligence — itself associated with analytic thinking and cognitive reflection — and religious disbelief have been observed (Zuckerman, Silberman & Hall, 2013). Additionally, atheism is overrepresented amongst elite scientists as compared with non-elite scientists and non-scientists (Larson & Witham, 1998).

Drawing on dual process theories of human cognition (Evans, 2003) and work on the putatively intuitive roots of religious belief (e.g., Atran & Norenzayan, 2004; Bloom, 2007; Boyer, 2008), three independent teams published highly similar findings in 2012, observing that individuals who perform better on a commonly used behavioral measure of cognitive reflection, the Cognitive Reflection Test (CRT, Frederick, 2005), tend to report lower levels of religious belief and have a higher probability of self-identifying as atheists (Gervais & Norenzayan, 2012; Pennycook, Cheyne, Seli, Koehler & Fugelsang, 2012; Shenhav, Rand & Greene, 2012). Additionally, two of the teams reported that subtle experimental prods designed to nudge people to think more analytically also led them to report lower levels of religious belief (Gervais & Norenzayan, 2012; Shenhav et al., 2012). These results were taken as strong support for analytic atheism, and received widespread attention, both within academia (averaging over 240 citations apiece as of December 2017, via Google Scholar) and within popular culture (one article is among the top articles ever scored by Altmetrics). This pioneering research on analytic atheism

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WMG developed the study design in consultation with all the authors. WMG performed the analyses and prepared the figures. WMG, MvE, JB, DX, and RMcK wrote the manuscript with input from all authors. All authors collected data.

[a]University of Kentucky (USA). Email: will.gervais@uky.edu.
[b]University of Amsterdam (Netherlands).
[c]University of Connecticut (USA).
[d]Royal Holloway, University of London (UK)
[e]American University of Sharjah (United Arab Emirates).
[f]Education University of Hong Kong (Hong Kong).
[g]The University of Sydney (Australia).
[h]Masaryk University (Czech Republic).
[i]Singapore University of Social Sciences (Singapore).
[j]University of Helsinki (Finland)
[k]Victoria University of Wellington (New Zealand).

spawned numerous follow-ups, and a recent meta-analysis of all 31 known studies (total $N > 15000$) on the topic found a stable, albeit small, negative correlation between cognitive reflection and religious belief (Pennycook, Ross, Koehler & Fugelsang, 2016).

Despite widespread enthusiasm for analytic atheism, there are several reasons to be skeptical about the mechanisms suggested by its proponents. First, there is only one known successful replication of any of the early experimental work suggesting that subtle primes for cognitive reflection actually increase atheism (Yilmaz, Karadöller & Sofuoglu, 2016). Second, independent investigations have found that other experimental prods to think analytically do not reliably reduce religiosity (Yonker, Edman, Cresswell & Barrett, 2016). Third, one multi-site, preregistered study (Sanchez, Sundermeier, Gray & Calin-Jageman, 2017) did not replicate one of the early experimental studies (Gervais & Norenzayan, 2012, Study 2). Recent work also questions the supposedly intuitive underpinnings of religious cognition (Farias et al., 2017). More fundamental, however, the clear majority of work on cognitive style and religious belief has taken place in North America, either in university settings or via Mechanical Turk, with rare exceptions (Yilmaz et al., 2016; Yilmaz & Saribay, 2016). Even if a correlation between cognitive reflection and religious disbelief turns out to be supported in North America, the degree to which such processes generalize widely beyond WEIRD (Western, Educated, Industrialized, Rich, Democratic: Henrich, Heine & Norenzayan, 2010) cultural contexts is still largely unknown. Certain features of religious beliefs vary strongly by culture (Purzycki et al., 2016), while others appear to be relatively stable (Gervais et al., 2017). It would be fortuitous and elegant if a parsimonious explanation of religious disbelief arising from cognitive reflection were generalizable to all or most cultures. However, set against a wider empirical background, the degree to which we can generalize the North American analytic atheism findings — both the unsettled experimental work, and the reliable but small correlations — remains an open question.

A strong version of the analytic atheism thesis is that analytic cognitive style and cognitive reflection should generally predict lower belief in gods. This predictive effect should be both *substantial* and *universal*. That is, the strong version of analytic atheism specifies that analytic thinking and cognitive reflection are primary drivers of atheism worldwide, implying that the magnitude of effect sizes must be more than modest. Further, a strong version of analytic atheism does not easily predict cross-cultural heterogeneity in the magnitude of the predictive effect of cognitive reflection on religious disbelief.

Here, we systematically evaluate the association between cognitive reflection and religious disbelief across 13 religiously, demographically, and culturally diverse societies. Sampled societies range from highly religious countries such as India to highly secular countries such as the Netherlands and China. Societies also differ in their majority religious composition, from Buddhist (Singapore), to Christian (USA), to Hindu (Mauritius), to Muslim (United Arab Emirates), to nonreligious (Czech Republic) traditions, and others. This multi-site design allows us to step beyond debates about mere replicability by additionally assessing the cross-cultural generalizability of a widely-discussed mechanism underlying atheism.

2 Method

Participants in all 13 countries completed the CRT, and a face-valid item of religious belief, rating strength in belief in God or gods from 0 (definitely does not exist) to 100 (definitely exists). Crucially, both the CRT and the belief in God(s) item were used in one of the initial studies on cognitive reflection and religion (Gervais & Norenzayan, 2012, Study 1) allowing for direct replication, comparison, and extension. The countries were convenience sampled[1], but selected to represent a broad range of religious backgrounds. Most participants were young, and 9 samples were students (Table 1). Data from 12 countries were obtained from an existing dataset from a previous unrelated project (Gervais et al., 2017), while United States data were taken from a larger university sample, allowing increased estimate precision. Participants in China and India were directly paid for their participation; Australia, Czech Republic, Hong Kong, the Netherlands, New Zealand, Singapore, United Arab Emirates, the United Kingdom, and the USA were student samples participating either for course credit or to be enrolled in a lottery. The Indian participants were recruited from Mechanical Turk and were screened to include only participants who reported not having previously done the CRT. Additional demographic and methodological details are available in a supplement at https://osf.io/p5h6s/.

We note that the present study was not fully preregistered, although our initial recruitment and preregistration in the original project (https://osf.io/f6tcr/) did mention the possibility of using collected data to run the present analyses separately. In total, we analyzed data from 3461 participants (69% female) across 13 countries.[2] This number far exceeds the sample size of most social psychological research (including research on this topic) and provides an adequate sample size for good estimate precision on the aggregate analysis. In addition, our per-country sample sizes were on par with previous analytic atheism research. Table 1 displays

[1] They are basically countries where Gervais had contacts.

[2] 4051 participants completed at least some of the questions. 384 participants were omitted because they failed an attention check. After omitting these participants, participants who provided responses outside of acceptable ranges, and participants who did not complete all measures of interest were omitted; 3461 participants were retained for full analyses.

TABLE 1: Brief demographics of samples in 13 countries. CRT scores reflects the number of correct answers provided on the CRT out of 3 possible; higher scores reflect greater cognitive reflection. Belief in God was rated from 0–100.

Country	N	Mean Age [SD]	Mean CRT [SD]	Mean Belief [SD]	Source
Australia	143	20.11 [5.34]	1.28 [1.20]	54.82 [38.83]	students
China	207	29.82 [5.95]	1.80 [1.04]	28.74 [35.71]	community
Czech Republic	187	21.96 [2.09]	1.06 [0.87]	47.23 [39.88]	students
Finland	992	28.15 [8.23]	1.76 [1.10]	31.28 [35.32]	mixed
Hong Kong	128	21.01 [2.97]	1.37 [1.13]	62.94 [36.20]	students
India	224	30.79 [8.38]	1.42 [1.17]	85.69 [25.70]	community
Mauritius	161	21.73 [1.33]	1.13 [0.97]	76.46 [39.21]	community
Netherlands	212	19.49 [2.14]	1.12 [1.03]	21.23 [29.96]	students
New Zealand	160	23.06 [7.98]	1.24 [1.11]	41.48 [39.84]	students
Singapore	161	20.83 [1.69]	1.83 [1.01]	69.75 [30.39]	students
UAE	145	19.92 [1.57]	0.63 [0.93]	94.24 [19.04]	students
UK	150	25.33 [9.60]	1.30 [1.20]	34.26 [36.90]	students
USA	591	19.36 [3.07]	0.77 [1.04]	79.55 [32.04]	students

descriptive statistics for each country's data. Data and code are available at https://osf.io/v53c4/.

3 Results

We conducted a Bayesian hierarchical (multilevel) model (fit by the R package from McElreath, 2016, version 1.59) that provides parameter estimates within each country, as well as an overall estimate that is directly equivalent to performing a meta-analysis on the whole dataset (Vuorre, 2017). Bayesian analyses offer many benefits (Wagenmakers, Morey & Lee, 2016) such as producing intuitive probability statements for the credibility of different parameter estimates, contingent on data and model (Kruschke, 2010; McElreath, 2016). We used non-informative and mildly regularizing priors, primarily deployed to combat model overfitting (McElreath, 2016). In addition, the Bayesian hierarchical framework alleviates some concerns of multiple testing, which would be problematic when performing separate analyses on each of the 13 countries (Gelman, Hill & Yajima, 2012). Our final model treated intercepts and slopes of CRT as random across countries, and included age and gender as fixed covariates. These were the only variables shared and uniformly coded across all 13 sites.

The primary inference in Bayesian estimation is the full posterior distribution of all estimates. The posterior distribution indexes how plausible or credible it is that different potential parameters could have yielded the observed data. Figure 1 displays the posterior distributions for unstandardized betas, which represent the predicted change observed in individual belief in God as performance on the CRT increases by each additional correct answer. When interpreting posterior distributions, tighter and taller distributions reflect less estimate uncertainty than do flatter distributions, and the relative height along the curve indexes relative estimate credibility. For example, if the top of the curve is twice as tall as another point, that means that the estimate at the top of the curve is twice as good of a guess for the underlying parameter. Figure 1 also displays the posterior probability that cognitive reflection predicts nonzero and negative changes in belief in God. The posterior probability is in many ways analogous to how many intuitively misinterpret directional frequentist p-values: as the probability of a given effect existing (Oakes, 1986). In addition to the posterior distributions, Table 2 also summarizes the posterior predictions with the posterior mean as a point estimate and uncertainty around this estimate reflected by highest posterior density intervals (HPDI), which index the range in which the 95% most credible estimates lie. This is similar to how frequentist confidence intervals are often intuitively misinterpreted (Hoekstra, Morey, Rouder & Wagenmakers, 2014).

As Table 2 illustrates, and consistent with the cross-cultural psychology of religion, there was substantial heterogeneity in average belief in God across sites (random intercepts). The posterior probabilities in the right of Figure 1 show relatively strong overall evidence for a CRT-disbelief link aggregating across all countries, but among individual countries only Australia, Singapore, and the USA show unequivocal evidence of a CRT-religious disbelief link. New Zealand, the Netherlands, and the Czech Republic produced almost perfectly equivocal evidence of analytic atheism (posterior probabilities of basically .5) and the UK actually shows moderate evidence of a sign reversal whereby

TABLE 2: Full summary of model coefficients. Mean = posterior mean, SD = posterior standard deviation, lower and upper refer to the lower and upper bounds of a 95% highest posterior density interval. ρ refers to the covariance between model intercepts and βs (betas) across countries. Standardized βs for slopes appear in brackets.

	Mean	SD	lower	upper
Intercepts				
Total	55.95	6.66	42.66	69.08
Australia	54.70	2.84	49.07	60.19
China	30.71	2.55	25.70	35.69
Czech	47.58	2.51	42.65	52.49
Finland	31.65	1.21	29.28	34.02
Hong Kong	62.23	2.98	56.40	68.09
India	85.92	2.35	81.31	90.49
Mauritius	77.05	2.70	71.72	82.31
Netherlands	21.19	2.38	16.49	25.81
New Zealand	41.69	2.66	36.45	46.89
Singapore	72.43	2.90	66.71	78.11
UAE	91.75	3.17	85.65	98.06
UK	34.65	2.75	29.19	39.98
USA	77.17	1.60	74.03	80.31
Unstandardized βs				
Female	3.07	0.60	1.91	4.24
Age	−0.10	0.70	−1.45	1.29

	Mean	SD	lower	upper
CRT				
Total	−1.89 [−.05]	1.06	−4.00 [−.12]	0.22 [.02]
Austr.	−4.59 [−.14]	2.00	−8.60 [−.26]	−0.94 [−.03]
China	−2.44 [−.07]	1.82	−6.11 [−.17]	1.05 [.03]
Czech	0.58 [.03]	2.12	−3.33 [−.09]	4.88 [.15]
Finland	−1.18 [−.03]	0.92	−2.99 [−.08]	0.63 [.02]
H.K.	−1.83 [−.05]	1.86	−5.44 [−.16]	1.98 [.06]
India	−2.81 [−.08]	1.59	−5.88 [−.17]	0.37 [.01]
Maurit.	−2.85 [−.08]	1.92	−6.70 [−.19]	0.97 [.03]
Neth.	0.24 [.01]	1.79	−3.24 [−.09]	3.81 [.11]
N.Z.	0.05 [.01]	1.85	−3.40 [−.09]	3.84 [.11]
Sing.	−5.55 [−.17]	2.24	−10.00 [−.30]	−1.41 [−.05]
UAE	−3.46 [−.10]	2.09	−7.65 [−.23]	0.66 [.02]
UK	2.55 [.09]	2.21	−1.64 [−.03]	6.86 [.21]
USA	−3.40 [−.10]	1.20	−5.78 [−.16]	−1.08 [−.03]
$\rho_{(\text{Int.},\beta)}$	−0.39	0.26	−0.85	.12

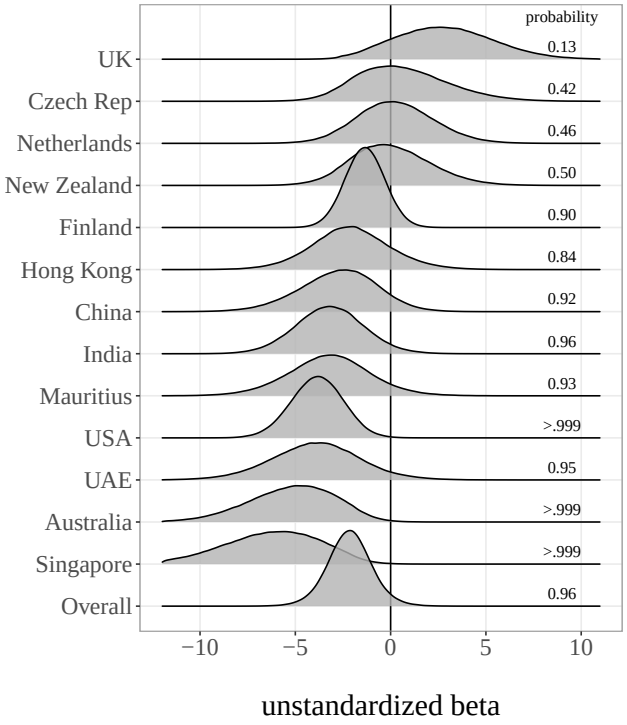

FIGURE 1: Cognitive reflection predicting belief in God across 13 countries. Plot shows the posterior distribution for unstandardized betas, as well as the posterior probability that CRT performance predicts lower religious belief across sites. Estimate precision is largely driven by per-country sample size (Table 2).

analytic thinkers were mildly more religious.[3] Most of the posterior densities' masses are quite close to zero, suggesting that any relationships between CRT performance and religious disbelief within countries were modest, in even the few cases where they were reliably evident.

Given the non-standardized and non-representative sampling strategies employed across sites, and the predominance of students in the samples, we are reluctant to over-interpret potential causes for why the CRT-disbelief relationship is so fickle across sites. However, our model estimates a .92 posterior probability of an inverse relationship between slopes and intercepts indicating that the analytic atheism relationship was apparently strongest in sites more reliably religious (Figure 2, Table 2).[4] Speculating, it is possible that cogni-

[3] To test heterogeneity of the CRT effect across countries, we compared two models fit with the lmer() function in the lme4 R package. One model regressed belief in god on CRT score, with a random effect for country and a random slope for CRT within country. The other was the same but without the random slope. The different was significant at p<.006 by analysis of variance.

[4] In a post-hoc regression across the 13 countries, with a measure of analytic atheism (the CRT effect) as the dependent variable and two predictors, mean CRT score and mean belief in God, the effect of belief in God was highly significant ($p < .005$), supporting the observation that the effect is largest in the less secular countries. Mean CRT score had no effect.

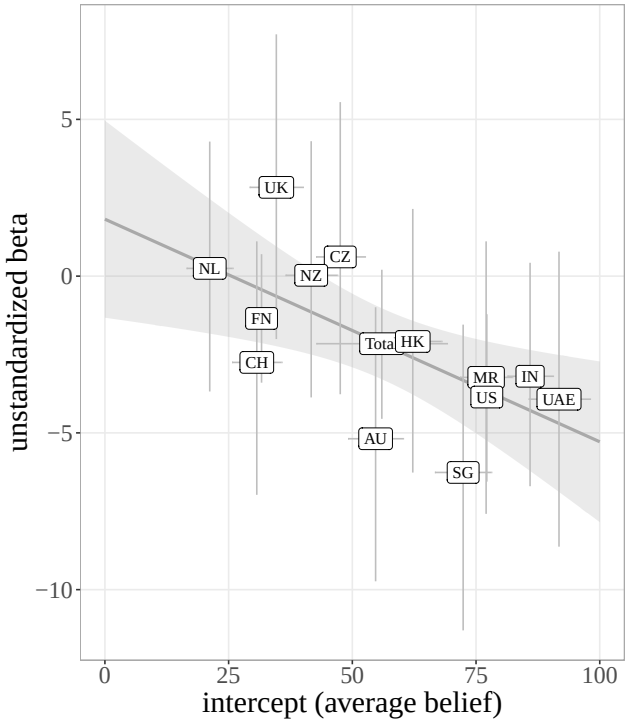

FIGURE 2: Posterior summaries for the average belief within each country and the unstandardized beta within each country. Model predicts a stronger relationship between CRT and religious disbelief in more religious countries. X-axis depicts modeled random intercepts, y-axis depicts modeled random slopes. Vertical lines reflect 95% HPDIs in betas and horizontal lines reflect 95% HPDIs in intercepts.

tive reflection measures are tapping a tendency to question prevailing cultural norms. In cultures where institutional religion is waning and where acceptance of atheism arises from tendencies to conform, it is possible that cognitive reflection may predict the rejection of atheism, a matter for future investigation. Here, we infer only that the relationship between cognitive reflection and disbelief is globally both weak and fickle.

4 Discussion

Models for an inverse relationship between cognitive reflection and religious belief — here termed *analytic atheism* — have sparked both scholarly and popular interest. However, the magnitude and cross-cultural generalizability of this relationship has not to date been thoroughly and directly investigated. Here, we report data from 13 diverse countries, and find quite mixed evidence. At the aggregate level, our model predicts a .96 probability that cognitive reflection is associated with religious disbelief. Though reliable, this effect is small, as after adjusting for country-level dependencies each additional correct CRT item predicts a reduction in belief in God of less than 2 points on a scale of 0 to 100, standardized $\beta = -.05$ [−.12, .02]. Within individual countries, cognitive reflection was, at best, a fickle predictor of religious disbelief. Four relatively secular countries — New Zealand, the Netherlands, the Czech Republic, and the UK — did not even produce estimates that were reliably directionally consistent with the analytic atheist thesis. When a relationship between cognitive reflection and religious disbelief was strongly apparent (in aggregate across sites, and within Australia, Singapore, and the USA) or hinted at (in the bulk of sampled countries), this relationship was quite modest in magnitude, yielding standardized betas that hovered at −0.10 or weaker. Thus, cognitive reflection may not actually be an especially potent global predictor of atheism.

4.1 Future Questions and Constraints on Generality

The present paper utilized the CRT as a sole measure of cognitive reflection. The CRT is widely used, but may not measure the most relevant sort of reflection very well (Baron, Scott, Fincher, & Metz, 2015). Similar and convergent measures of analytic thinking and cognitive reflection also similarly predict religious disbelief (Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2014a; Saribay & Yilmaz, 2017), bolstering the claims to generalizability across measures and also, possibly, providing more direct measures of the relevant traits. Likewise, the single-item belief measure is potentially problematic. There are may ways to "believe in God", some of which may be impervious to any sort of reflection. Cognitive reflection differentially predicts different facets of religiosity (Bahçekapili & Yilmaz, 2017), as well as religious affiliation (Pennycook et al., 2012) and other related constructs (Pennycook, Cheyne, Barr, Koehler & Fugelsang, 2014b; Saribay & Yilmaz, 2017; Yilmaz & Saribay, 2016). And other measures of reflection, as well as CRT items, predict specific religious beliefs such as endorsement of "divine command theory" Piazza & Landy, 2013; Baron et al., 2015), a view that explicitly discourages reflection on the ground that the word of God is beyond human understanding.

The present paper can serve as a jumping board for additional cross-cultural exploration. The present results move well past the WEIRD samples (Henrich et al., 2010) that exemplify social psychology. Although we used a relatively large cross-cultural sample, our findings would benefit from extension to other contexts, such as small-scale, hunter-gatherer communities, or older adults. In addition, our results present only suggestive evidence for the factors predicting cross-cultural differences in analytic atheism. Given that the strongest effects in the present study tended to emerge from highly religious societies and that our sampling is, if anything, skewed towards highly secular societies, we may well observe more robust evidence of analytic atheism in

other samples from highly religious societies. We would expect that strength of cultural support for religion and analytic atheism interacts: without some sufficient level of cultural support, there may be no need for people to analytically override religious impulses and instruction. Furthermore, if cognitive reflection (or some other measure) were tapping a capacity to question prevailing cultural norms, it is possible that cognitive reflection may predict the rejection of institutional atheism in some highly secular contexts.

4.2 Coda

Though *Homo sapiens* is a religious species, atheism exists in all known societies, and is growing increasingly prevalent across industrial societies — perhaps to an underappreciated level due to underreporting (Gervais & Najle, 2018). Researchers have theorized that analytic thinking and cognitive reflection are engines of religious skepticism. Consistent evidence for a positive association between cognitive reflection and religious disbelief has been primarily found in WEIRD samples. The present study provides a broader cross-cultural evaluation of analytic atheism. We observe that the analytic thinking model of religious disbelief (e.g., Bloom, 2007; Boyer, 2008) may overstate the magnitude and cross-cultural generalizability of any relationship between cognitive reflection and atheism as usually measured. In our view, these results outright falsify two claims central to a strong version of analytic atheism: the effect is neither consistent across cultures nor large enough to be a primary driver of atheism in the simple way we and many others have measured it. Indeed, according to the present results, if one wants to predict a stranger's degree of religious belief, they may be better off knowing where the stranger is from rather than how analytically the stranger thinks. Speculatively, it is possible that cognitive reflection is related to a tendency to challenge culturally dominant orthodoxies in general. However, whether this is so, and where the causal arrows flow, are matters for future cultural psychological research. For now, the present study contributes to psychological science in challenging the ubiquity of the analytic atheism model, while also contributing to growing awareness about the limitations of inferring human universals from WEIRD samples, and demonstrating the power of cross-cultural approaches to clarify how core beliefs arise from an interplay of individual differences and local cultures.

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